SP-025

manual for condition rating of gravel surface roads

Technical Report Documentation Page

Manual for Condition Rating of Gravel Surface Roads

Author:	G.J. Chong G.A. Wrong	Pavements and Roadway Office, Research and Development Branch Design Evaluation and Pavement Section, Highway Design Office

Number:	SP-025	ISBN 0-7729-5832-7 ISSN 0226-9414
Date of Publication:	August 1989	
Ministry Contact:	Pavements and Roadway Office, Research and Development Branch (416) 235- 4742	

Abstract:	Most highway authorities use roadway surface condition ratings to judge the roadway's ability to continue providing required service to the public. Municipalities in Ontario have the same duty to monitor and maintain roads in their respective communities. Riding quality and distress manifestations are the basis of the condition rating scheme used in Ontario by the Ministry of Transportation. However, a scheme is required that specifically addresses the unique conditions and needs for gravel surface roads. This document was prepared to meet this roadway management need and to present a roadway condition rating scheme for gravel surface roads for the Ministry and is also suitable for adaptation by municipalities in Ontario.

Comments:	
Key Words:	roadway surface condition rating, distress manifestations, treatment alternatives
Distribution:	Regional Geotechnical Offices, Municipal Road Offices, (Municipalities on request)

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Ontario

Ministry of Transportation

Research and Development Branch

SP-025

manual for condition rating of gravel surface roads

G.J. Chong
Research Engineer
Pavements and Roadway Office
Research and Development Branch

G.A. Wrong
Head, Design Evaluation and Pavement Section
Highway Design Office

Published by
The Research and Development Branch
Ministry of Transportation of Ontario
Hon. William Wrye, Minister
D.G. Hobbs, Deputy Minister

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For additional copies, contact:
The Editor, Technical Publications
Room 320, Central Building
1201 Wilson Avenue
Downsview, Ontario
Canada M3M 1J8

Telephone: (416) 235-3480
Fax: (416) 235-4872
CNCP Dialcom Electronic Mail: 23:MIN006

August 1989

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1/ Introduction

Rating of highway pavement surface condition is used in one form or another by most highway agencies to measure the ability of the roadway surface to continue to provide the required service to the public. The most important applications for condition rating are their uses in determining deficiencies, inadequacies, remedial measures, fiscal needs and in planning and programming. The pavement condition rating scheme used in Ontario by the Ministry of Transportation is based on two inter-related measures: *riding quality* and *distress manifestations* [1, 2, 3, 4].

In addition to managing a network of hard surfaced roads, such as asphaltic concrete, asphaltic surface-treated and Portland-cement-concrete surfaced pavements, the Ministry also manages a network of gravel surface roads which serve smaller and more remote population centres in the province. In addition, the Ministry subsidizes a network of gravel surface roads under the jurisdiction of local Ontario municipalities. The combined length of gravel surface roads under the Ministry and the municipalities comprises more than 50% of the total road mileage in the province.

The existing pavement condition rating systems used in Ontario [1,2,3,4] are designed only for hard surfaced roads. To date, there has been no system designed and developed specifically to address the unique performance pattern of gravel surface roads.

This document was prepared to meet this need and to present a roadway surface condition rating system for gravel surface roads.

2/ Pavement Surface Condition Rating System

The standard rating scheme devised for use in Ontario consists of a rater evaluating two different physical parameters:

- the riding quality of the pavement surface; and
- the extent and severity of roadway surface distress manifestations [1, 2, 3, 4, 5].

These two physical parameters are inter-related in that some distress manifestations result in surface distortion and unevenness which then cause a reduction in riding quality. A prime example is washboarding from traffic action which results in a rough ride for the road users. In turn, rougher roads cause vehicles to produce higher dynamic wheel loads, thus increasing stresses, strains, and deflections, thus hastening roadway deterioration. Not all distress manifestations are accompanied by distortion or unevenness; dust is a good example. The type, density and severity of distress are very useful indicators of structural inadequacy, materials deficiency and probable rate of subsequent deterioration.

The rating system devised for use in Ontario for gravel surface roads consists of a rater evaluating only one physical parameter; that is:

- the extent and severity of roadway surface distress manifestations.

The rationale for this approach is:

- With one exception, all roadway surface distress manifestations are related to riding condition of the roadway surface. The extent and severity of distress manifestations dictate the riding quality of the gravel surface roads.
- Ride condition of gravel surface roads can change within a very short time span due to external factors such as inclement weather, etc.
- Ride condition of gravel surface roads can also change periodically depending on the maintenance dragging schedule carried out by each road agency as a matter of policy.

Distress manifestations of roadway surface may be grouped under two main headings:

- surface defects
- surface deformation

The different distress manifestations have been assigned names, which are listed in Figure 1. Each type of distress is described in terms of its physical appearance and an array of possible causes is suggested for each. Each type of distress is evaluated in terms of the extent or density of occurrence and in terms of its severity. Uniform word descriptions are given to correspond with each category of density or severity.

"Pavement Condition Rating" is to be carried out in late spring, to allow for the effects of frost action to be still visible. If this is not possible, the rating should be carried out in mid-summer. It is suggested that the evaluation section should not be less than 1.6 km (1 mile) in rural situations; in the case of urban streets the distance between two intersections. Intersections should be included as part of the evaluation section for both rural and urban situations.

Shoulder distresses, in the case of gravel surface roads, do directly affect the roadway surface condition and contribute to the overall performance. Therefore, evaluation of shoulder distresses must be made to round out the total performance picture.

Distress manifestations of the shoulder are listed under the following headings:

- excessive height
- ponding
- overgrowth

Although the purpose of the rating system is to describe distress manifestations of the road surface, possible corresponding remedial measures are also suggested under each distress manifestation for maintenance action. It should be understood, however, that the possible remedial measures suggested for a deficiency are all short-term. Remedial measures for gravel surface roads are generally restricted to the following four:

- dust control additives
- dragging
- grading
- grading with addition of gravel

"Pavement Condition Ratings" are needed at regular intervals so that management will be aware of changing conditions. This is especially true in the case of gravel surface roads where conditions can change quite rapidly over a short time. Therefore, the completeness and uniformity of condition reports should lead to increased confidence in the planning of major maintenance or rehabilitation. The preferred cycle for roadway condition evaluation is one year, but if this is not feasible or economical, the maximum interval is three years.

Figure 1/ Roadway Surface and Shoulder Distress Manifestations

Roadway Surface Distress Manifestation	Evaluation		
	Severity	Density	Other Characteristics
Roadway Surface Defects			
• Loose Gravel			
• Dust			
• Potholes			
• Breakup			
Roadway Surface Deformation			
• Washboard			
• Rutting			
• Flat or Reverse Crown			
• Distortion			
Shoulder Distress Manifestation			
• Excessive Height			
• Ponding			
• Overgrowth			

3/ Distress Manifestation

Distress manifestations are visible signs of road surface condition. These distresses are indicators of problems due to either materials deficiencies, construction or maintenance deficiencies, environmental and climatic conditions, traffic loading, or other causes. The degree of severity and density, or extent of occurrence of these distresses are good indicators of the problem situation at hand [6,7].

Severity

The term "severity" simply indicates how bad the problem is. It is a scale based on past engineering experience. It has three levels — Slight, Moderate, and Severe. These guidelines give a verbal description of each stage, along with pictorial representations.

Density (Extent of Occurrence)

The term "density" simply describes how big the problem is. It is based on past engineering experience. It has three levels — Intermittent, Frequent and Extensive. These guidelines give a verbal description of each stage, based on the percentage of surface area affected and where it is affected.

For example, the rater may encounter the situation where there are a number of potholes located within a short distance of each other and this distance within the evaluation section represents less than 20% of the roadway surface area. Thus, the "density" is said to be "intermittent" (Figure 2).

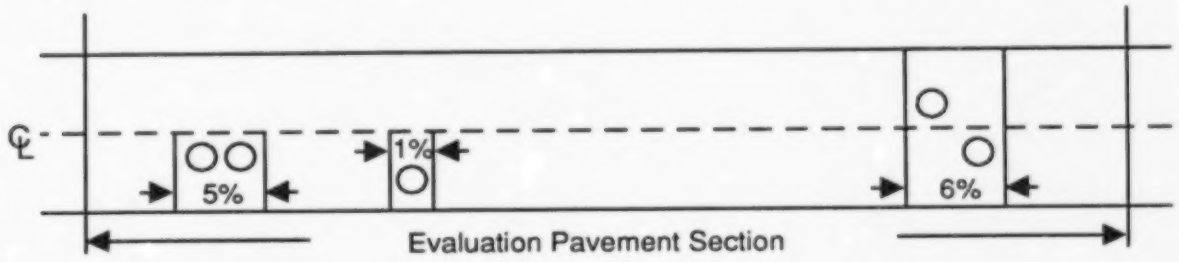


Figure 2/ Intermittent Occurrence of Potholes

On the other hand, if these same potholes are spaced over the length of the evaluation section, the distress is still "intermittent" because it is only an isolated incidence over a few areas of the total roadway surface (Figure 3).

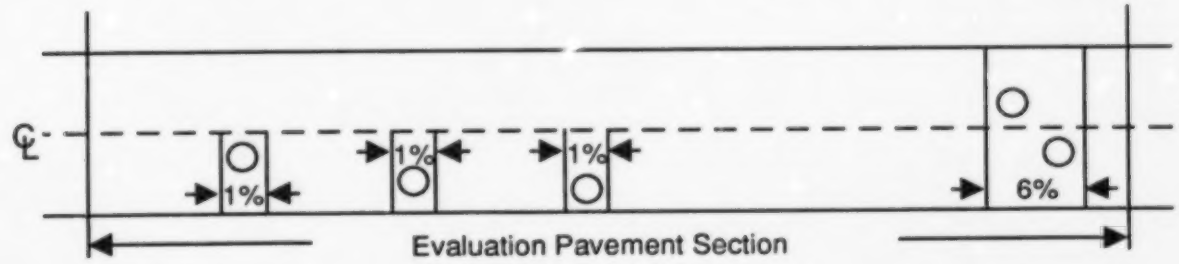


Figure 3/ Intermittent Occurrence of Potholes

However, if these potholes are present in clusters covering more than 20% and up to 50% of the roadway surface, it is said to be "frequent" (Figure 4).

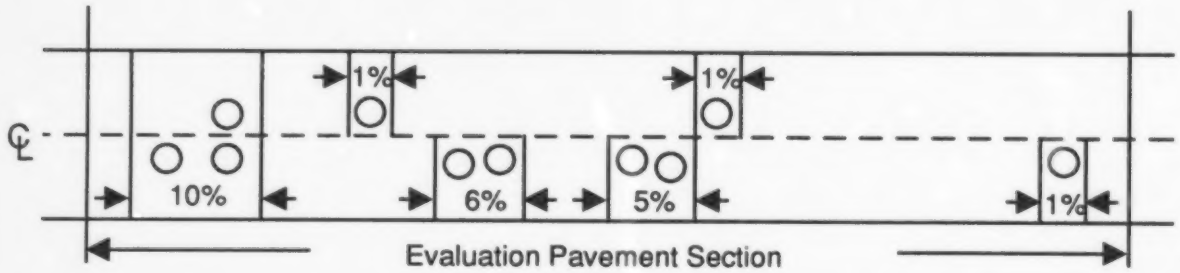


Figure 4/ Frequent Occurrence of Potholes

For "extensive" occurrence, the potholes are present over the length of the roadway section and cover more than 50% of the surface area (Figure 5).

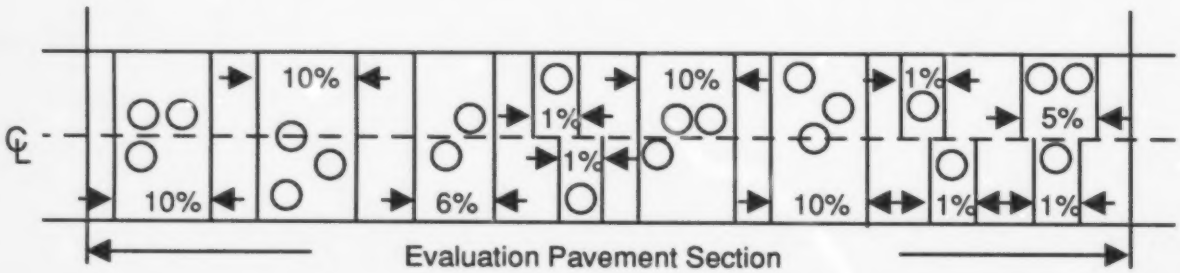


Figure 5/ Extensive Occurrence of Potholes

It should be noted that "coverage" here means that 20 to 50% of the roadway surface area has potholes. It does not mean potholes represent 20 or 50% of the roadway surface. These illustrations serve generally for all distress manifestations.

4/ Procedure for Roadway Evaluation

Step 1 To carry out the roadway condition evaluation, drive slowly over the road or street to establish the limits of the evaluation section. Each evaluation section should have a minimum length of 1.6 km for rural roads and the distance between two intersections for urban streets. The minimum length requirement is strictly for economic reasons.

Step 2 After establishing the evaluation section, assessment of the roadway surface condition is made by driving over the road slowly to assess distress manifestations (maximum speed not to exceed 50 km/h for rural roads, or 30 km/h for urban streets). Two or three stops per section should be made to examine distress type and severity, particularly surface deformations.

Step 3 After distress manifestations assessment, drive over the evaluation section at posted speed if possible to assess "dust" distress which is related to traffic action. Another means of evaluating this distress is to stop and observe the "dust" situation as traffic goes by.

Step 4 Complete the "Gravel Surface Pavement Condition Rating Form" by checking off the observed distress manifestations and shoulder distress manifestations (Figure A-1, Appendix A, page 57).

Step 5 Pavement Condition Rating (PCR) is assigned according to the Guide for the Estimation of Pavement Condition Rating for gravel surface roads (Table B-1) given in Appendix B, page 61.

5 / Surface Defects

Loose Gravel

Dust

Potholes

Breakup

Loose Gravel

Description:

Gravel surface loosely compacted; gravel in wind-rows along the centre of the road, alongside the wheel tracks, or along the shoulder, all parallel to the direction of traffic.

Possible Causes:

1. Insufficient or no compaction at construction, or during gravel replacement.
2. Traffic action segregates coarse aggregates from the fine particles and then moves loosened aggregates away from wheel tracks to form wind-rows parallel to the direction of traffic over the less traveled roadway surface areas.

Severity:

Class	Guidelines
Slight	Loose aggregate on the road surface, or the formation of a wind-row (less than 50 mm) anywhere on the roadway surface or shoulder.
Moderate	Loose aggregate on the road surface (mostly coarse aggregate) giving vehicle an unstable feel, or multiple wind-rows (50 to 200 mm) on the roadway surface or shoulder.
Severe	Loose aggregate on the road surface giving vehicle definite unstable feel, or multiple wind-rows (greater than 200 mm in size) on roadway or shoulder.

Density:

Class	Guidelines
Intermittent	Less than 20% of the roadway surface area affected. Distress spotted over localized area only.
Frequent	20 to 50% of the roadway surface affected. Distress spotted evenly over length of road section or over localized area only.
Extensive	Greater than 50% of the roadway surface affected. Distress spotted evenly over length of road section.

Slight Loose Gravel

Moderate Loose Gravel

Severe Loose Gravel

Treatments

Evaluation		Suggested Maintenance Treatment Alternatives
Severity	**Density**	
Slight	Intermittent	• Dragging and rolling
	Frequent	• Dragging and rolling
	Extensive	• Dragging and rolling
Moderate	Intermittent	• Dragging and rolling
	Frequent	• Dragging and rolling
	Extensive	• Dragging and rolling
Severe	Intermittent	• Dragging and rolling • Addition of fine aggregate with grading and rolling
	Frequent	• Addition of fine aggregate with grading and rolling
	Extensive	• Addition of fine aggregate with grading and rolling • Rehabilitation candidate

Dust

Description:

Traffic action creating a dust cloud which reduces safe sight distance for trailing and on-coming vehicles.

Possible Causes:

1. Traffic action causes segregation of fine aggregate particles from the coarse aggregates, and these fine particles become airborne from the whirlwind and slipstream caused by the moving vehicles.
2. Loose gravel surface combined with traffic action.

Severity:

Class	Guidelines
Slight	Thin dust cloud, no reduction in visibility.
Moderate	Dust cloud which reduces visibility, but vehicles are still visible in front, behind, or on-coming.
Severe	Dust cloud which reduces visibility almost completely, vehicle ahead can barely be seen by trailing vehicles. For on-coming traffic, only the two leading vehicles can be seen by each other.

Density:

Class	Guidelines
Intermittent	Less than 20% of the roadway surface area affected. Distress spotted over localized area only.
Frequent	20 to 50% of the roadway surface affected. Distress spotted evenly over length of road section or over localized area only.
Extensive	Greater than 50% of the roadway surface affected. Distress spotted evenly over length of road section.

Slight Dust

Moderate Dust

Severe Dust

Treatments

Evaluation		Suggested Maintenance Treatment Alternatives
Severity	**Density**	
Slight	Intermittent	• No action
	Frequent	• No action
	Extensive	• No action
Moderate	Intermittent	• No action
	Frequent	• Dust control additive
	Extensive	• Dust control additive
Severe	Intermittent	• Dust control additive
	Frequent	• Dust control additive
		• Rehabilitation candidate
	Extensive	• Rehabilitation candidate

Potholes

Description: Bowl-shaped depressions in the road surface. They can be round, oval, or irregular in shape.

Possible Causes:

1. Combination of excessive moisture and traffic action.
2. Frost action.
3. Inadequate structural strength in the roadway due to insufficient structural thickness.

Severity:

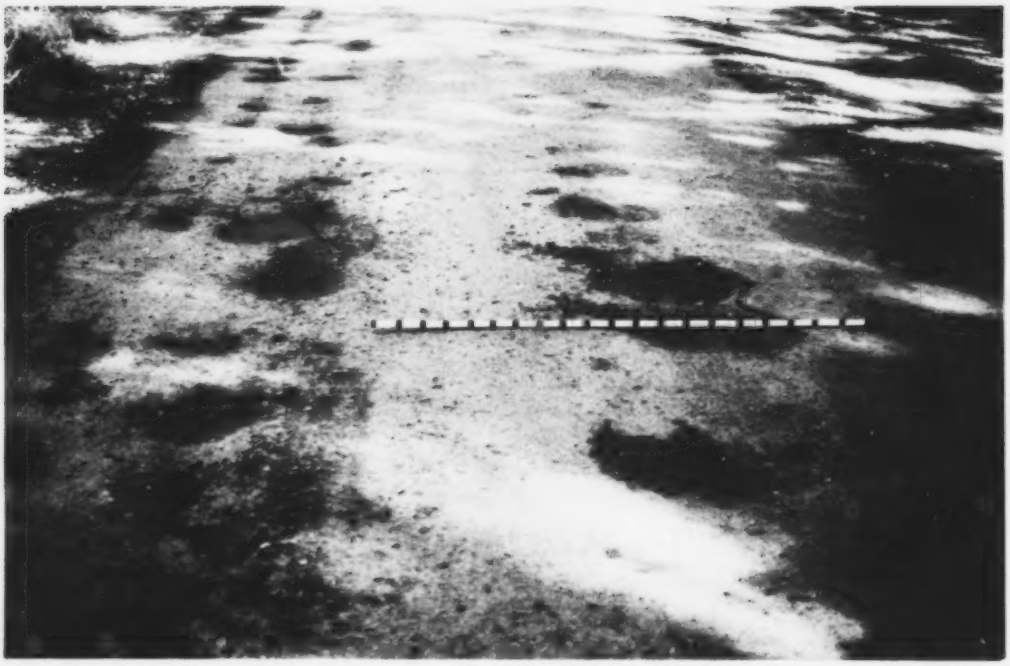
Class	Guidelines
Slight	Small and shallow in depth, less than 100 mm in diameter.
Moderate	100 to 300 mm wide and usually more than 50 mm deep.
Severe	More than 300 mm wide and usually more than 100 mm deep.

Density:

Class	Guidelines
Intermittent	Less than 20% of the roadway surface area affected. Distress spotted over localized area only.
Frequent	20 to 50% of the roadway surface affected. Distress spotted evenly over length of road section or over localized area only.
Extensive	Greater than 50% of the roadway surface affected. Distress spotted evenly over length of road section.

Slight Pothole

Moderate Pothole



Severe Pothole

Treatments

Evaluation		Suggested Maintenance Treatment Alternatives
Severity	**Density**	
Slight	Intermittent	• No action
	Frequent	• Dragging and rolling
	Extensive	• Dragging and rolling
Moderate	Intermittent	• Dragging and rolling
	Frequent	• Grading and addition of gravel and rolling
	Extensive	• Grading and addition of gravel and rolling
Severe	Intermittent	• Grading with addition of gravel and rolling
	Frequent	• Grading with addition of gravel and rolling
	Extensive	• Rehabilitation candidate

Breakup

Description: Subgrade soils punched up through the gravel surface, usually with the broken surface area surrounded by depression or dishing type of distortion. Distress most likely to occur at the wheel tracks.

Possible Causes:

1. Inadequate structural strength due to insufficient structural thickness.
2. Traffic action combined with excessive moisture from improperly drained surface.
3. Frost action.

Severity: All breakups are severe which require immediate corrective measure(s).

Density:

Class	Guidelines
Intermittent	Less than 20% of the roadway surface area affected. Distress spotted over localized area only.
Frequent	20 to 50% of the roadway surface affected. Distress spotted evenly over length of road section or over localized area only.
Extensive	Greater than 50% of the roadway surface affected. Distress spotted evenly over length of road section.

Severe Breakup

Severe Breakup

Treatments

Evaluation		Suggested Maintenance Treatment Alternatives
Severity	**Density**	
Severe	Intermittent	• Grading with addition of gravel and rolling
	Frequent	• Grading with addition of gravel and rolling • Rehabilitation candidate
	Extensive	• Rehabilitation candidate

6/ Surface Deformation

Washboard

Rutting

Flat or Reverse Crown

Distortion

Surface Deformation

Washboard

Description:

A series of closely-spaced crests and valleys which resembles an old fashioned "washboard" surface. Washboarding always occurs with the ripples perpendicular to the direction of travel and more pronounced at the wheel tracks, although it can and does cover the whole pavement surface area.

Possible Causes:

1. Traffic action combined with loose gravel.
2. Acceleration and deceleration areas such as curves, downhill or uphill, and intersections.
3. Insufficient structural strength or insufficient pavement structural thickness.

Severity:

Class	Guidelines
Slight	Less than 25 mm for crests and valleys. Vehicle bounces very little as it travels over the washboarding.
Moderate	25 to 50 mm for crests and valleys; vehicle chatters and bounces as it travels over the washboarding. Vehicle starts to slip sideways.
Severe	Crests and valleys greater than 50 mm; vehicle jumps as it travels over the washboarding. Vehicle slips sideways and driver must maintain firm steering control.

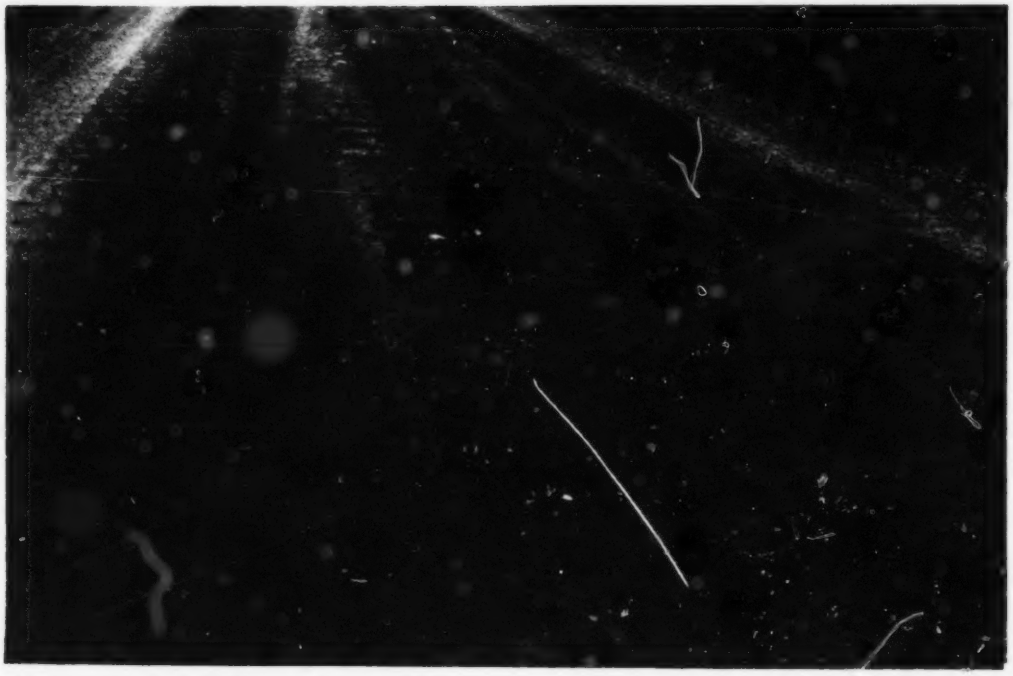
Density:

Class	Guidelines
Intermittent	Less than 20% of the roadway surface area affected. Distress spotted over localized area only.
Frequent	20 to 50% of the roadway surface affected. Distress spotted evenly over length of road section or over localized area only.
Extensive	Greater than 50% of the roadway surface affected. Distress spotted evenly over length of road section.

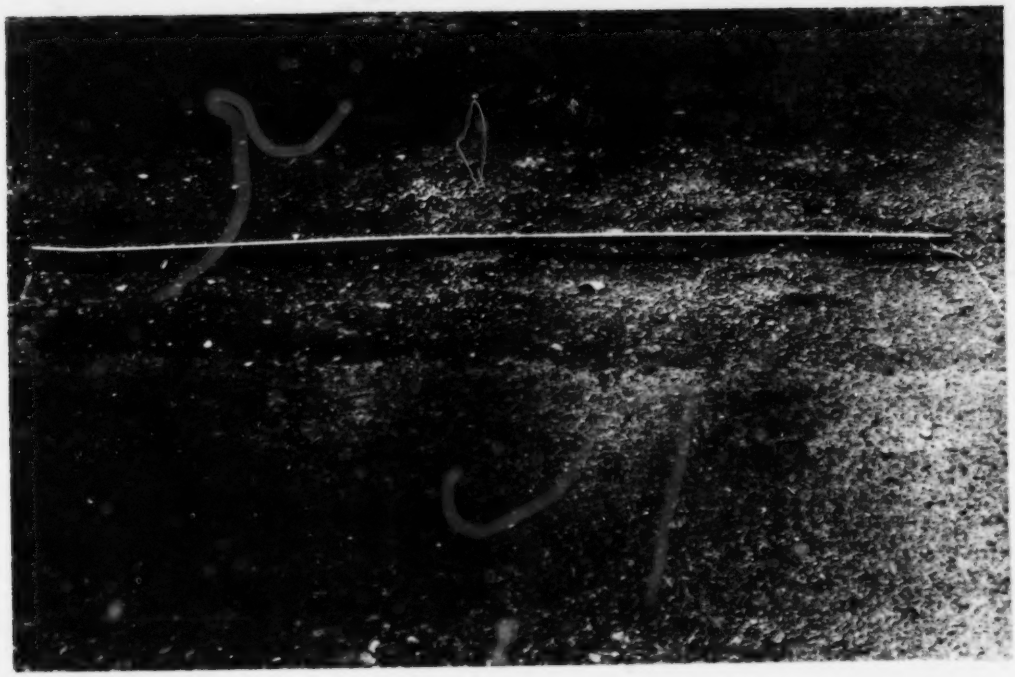
Slight Washboard

Moderate Washboard

Moderate Washboard



Severe Washboard



Severe Washboard

Treatments

Evaluation		Suggested Maintenance Treatment Alternatives
Severity	**Density**	
Slight	Intermittent	• No action
	Frequent	• No action
	Extensive	• No action
Moderate	Intermittent	• Dragging and rolling
	Frequent	• Dragging and rolling
	Extensive	• Grading with addition of gravel and rolling
Severe	Intermittent	• Grading with addition of gravel and rolling
	Frequent	• Grading with addition of gravel and rolling
	Extensive	• Grading with addition of gravel and rolling • Rehabilitation candidate

Surface Deformation

Rutting

Description:

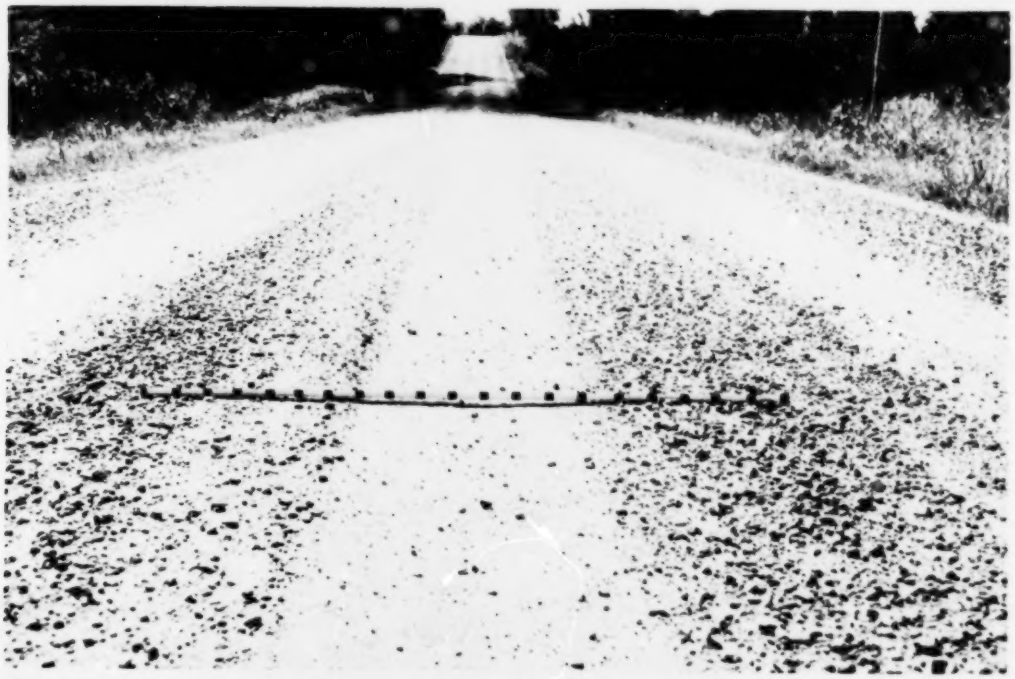
Rutting is a surface depression in the wheel path and is generally in the direction of traffic. It usually resembles a longitudinal trough.

Possible Causes:

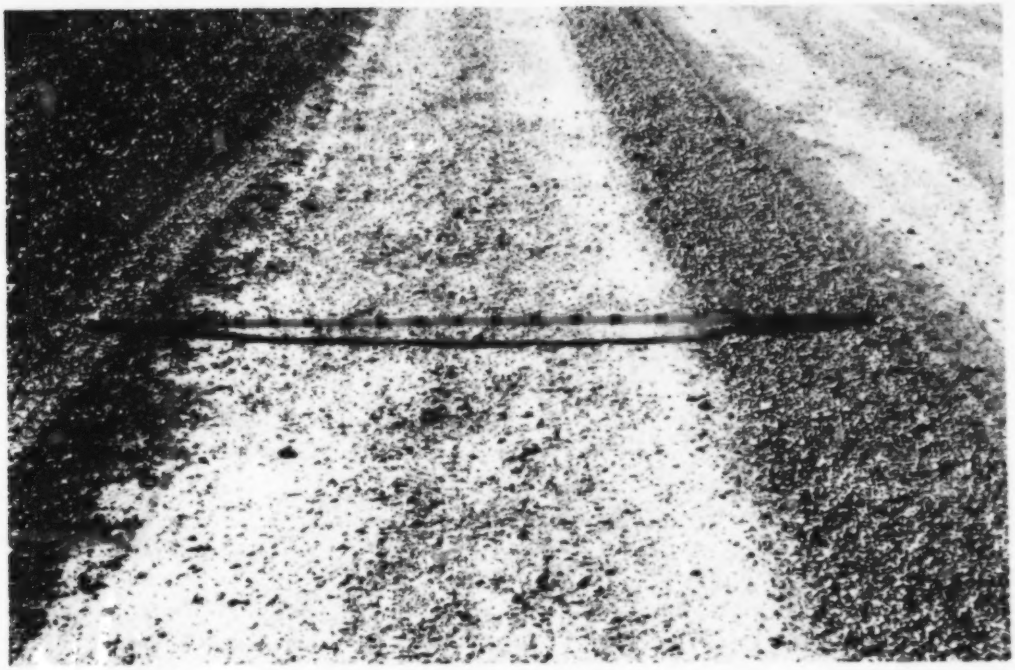
1. Traffic loadings.
2. Inadequate structural strength of the road layers or subgrade.
3. Excessive moisture in the road structure combined with traffic loadings.

Severity:	Class	Guidelines
	Slight	60 to 120 mm based on a 1.3 m baseline.
	Moderate	130 to 190 mm based on a 1.3 m baseline.
	Severe	200 mm upward based on a 1.3 m baseline.

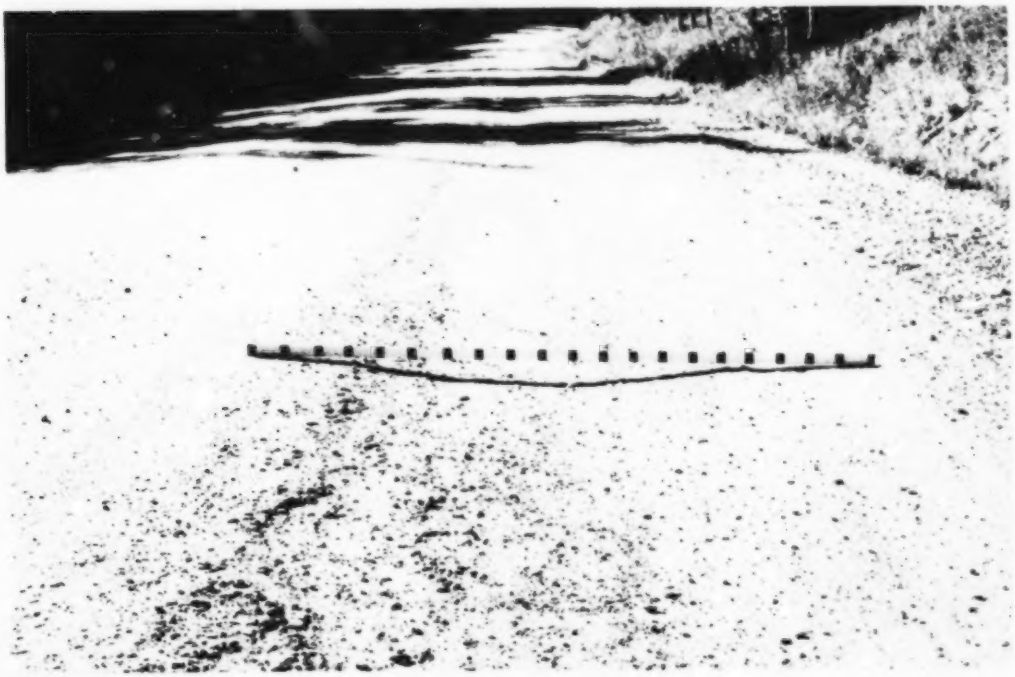
Density:	Class	Guidelines
	Intermittent	Less than 20% of the roadway surface area affected. Distress spotted over localized area only.
	Frequent	20 to 50% of the roadway surface affected. Distress spotted evenly over length of road section or over localized area only.
	Extensive	Greater than 50% of the roadway surface affected. Distress spotted evenly over length of road section.



Slight Rutting



Moderate Rutting



Severe Rutting

Treatments

Evaluation		Suggested Maintenance Treatment Alternatives
Severity	**Density**	
Slight	Intermittent	• No action
	Frequent	• No action
	Extensive	• No action
Moderate	Intermittent	• No action
	Frequent	• Grading and rolling
	Extensive	• Grading and rolling
Severe	Intermittent	• Grading with addition of gravel and rolling
	Frequent	• Grading with addition of gravel and rolling
	Extensive	• Grading with addition of gravel and rolling • Rehabilitation candidate

Surface Deformation

Flat or Reverse Crown

Description: Slope of the road is flat and non-existent, or reverse with road edges higher than the centre portion of the road surface.

Possible Causes:

1. Poor construction practices.
2. Poor maintenance practices.

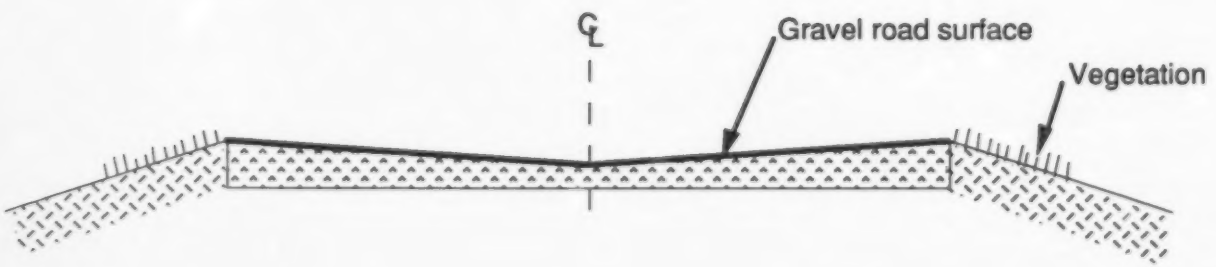
Severity:

Class	Guidelines
*Severe	Cross fall is flat or near flat, or when pavement edges are higher than road surface thereby trapping or preventing surface water to drain away.

Density:

Class	Guidelines
Intermittent	Less than 20% of the roadway surface area affected. Distress spotted over localized area only.
Frequent	20 to 50% of the roadway surface affected. Distress spotted evenly over length of road section or over localized area only.
Extensive	Greater than 50% of the roadway surface affected. Distress spotted evenly over length of road section.

**This distress manifestation has only one class for severity, that is "Severe".*



Reverse Crown of Gravel Road Surface

Treatments

Evaluation		Suggested Maintenance Treatment Alternatives
Severity	**Density**	
Severe	Intermittent	• Dragging and rolling • Grading and rolling
	Frequent	• Dragging and rolling • Grading with addition of gravel and rolling
	Extensive	• Grading with addition of gravel and rolling • Rehabilitation candidate

Surface Deformation

Distortion

Description:

Any deviation of road surface from its original shape (other than described for washboard or rutting). Distortion usually takes the shape of dishing, bumps or dips which are noticeable, all of which give rise to pitch, roll, or jarring drop in a moving vehicle.

Possible Causes:

1. Differential frost heave in poorly drained road surface areas.
2. Reverse differential frost heave at culverts.
3. Differential settlement of subgrade or base materials.
4. Lack of subgrade support.
5. Embankment slope failure.

Severity:

Class	Guidelines
Slight	Barely noticeable pitch and roll, or jarring drop of vehicle while in motion.
Moderate	Noticeable pitch and roll, or harsh drop of vehicle while in motion.
Severe	Continuous pitch and roll, or hard jarring drop of vehicle while in motion; driver must anticipate more distortion ahead and feels the need to reduce speed.

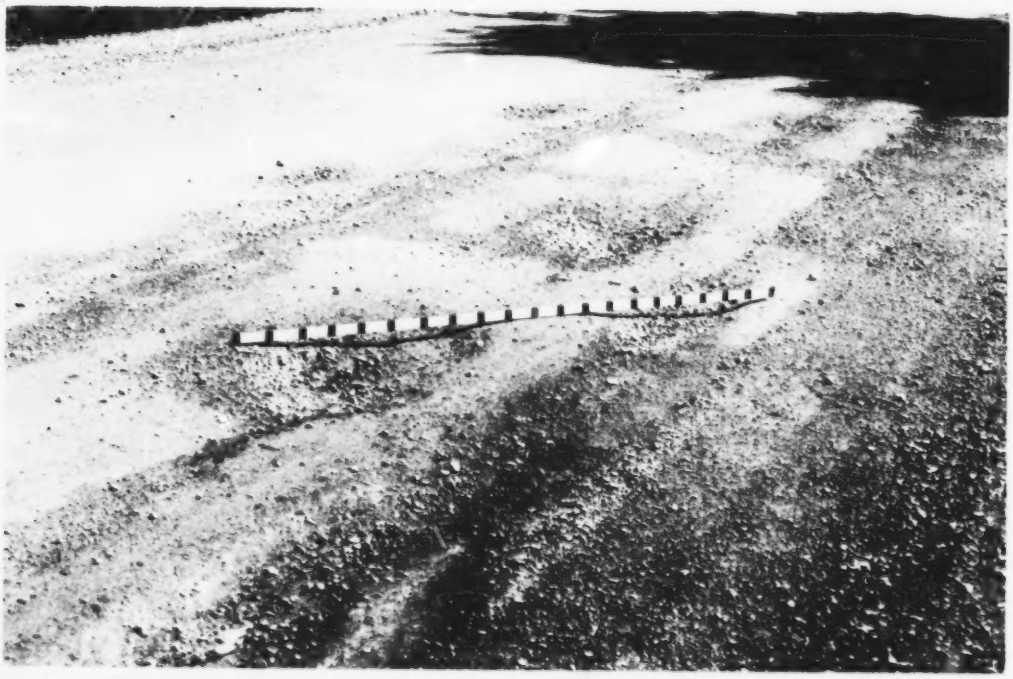
Density:

Class	Guidelines
Intermittent	Less than 20% of the roadway surface area affected. Distress spotted over localized area only.
Frequent	20 to 50% of the roadway surface affected. Distress spotted evenly over length of road section or over localized area only.
Extensive	Greater than 50% of the roadway surface affected. Distress spotted evenly over length of road section.

Slight Distortion

Moderate Distortion

Severe Distortion



Severe Distortion

Treatments

Evaluation		Suggested Maintenance Treatment Alternatives
Severity	**Density**	
Slight	Intermittent	• No action
	Frequent	• No action
	Extensive	• No action
Moderate	Intermittent	• Grading and rolling
	Frequent	• Grading and rolling
	Extensive	• Grading and rolling
Severe	Intermittent	• Grading and rolling • Grading with addition of gravel and rolling
	Frequent	• Grading with addition of gravel and rolling
	Extensive	• Grading with addition of gravel and rolling • Rehabilitation candidate

7/ Shoulder Distress Manifestations

Excessive Height

Ponding

Overgrowth

Shoulder Distress

Excessive Height

Description: Shoulder elevated over road surface, or excessive gravel wind-rows along roadway edge.

Possible Causes:

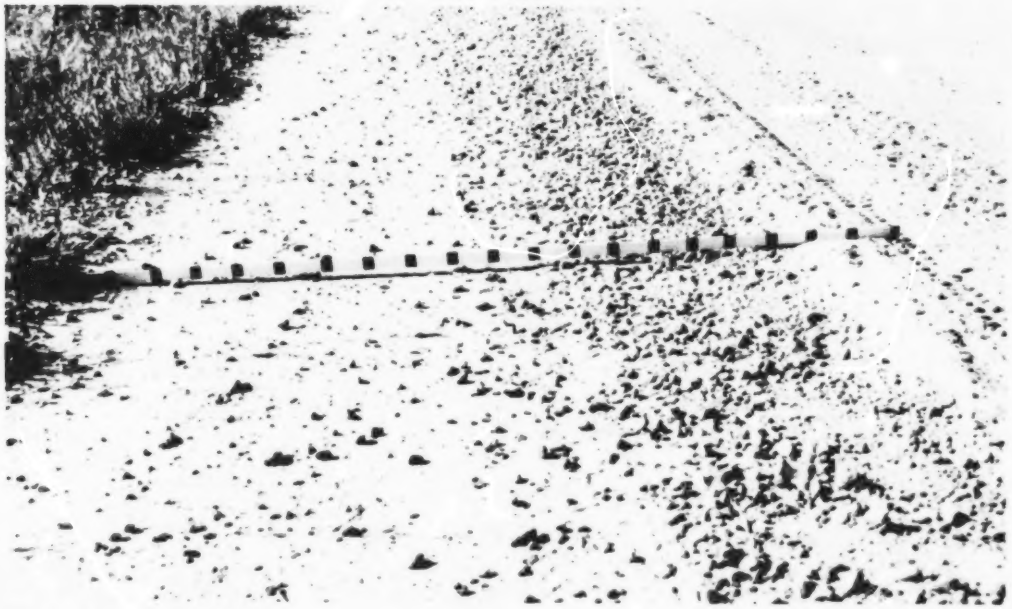
1. Loose gravel on road surface combined with traffic action.
2. Poor construction.
3. Improper maintenance.

Severity:

Class	Guidelines
Slight	Less than 50 mm difference in height, or wind-row formation.
Moderate	50 to 100 mm difference in height, or with multiple wind-row formations of 50 to 100 mm.
Severe	Greater than 100 mm difference in height, or with multiple wind-row formations of greater than 200 mm.

Density:

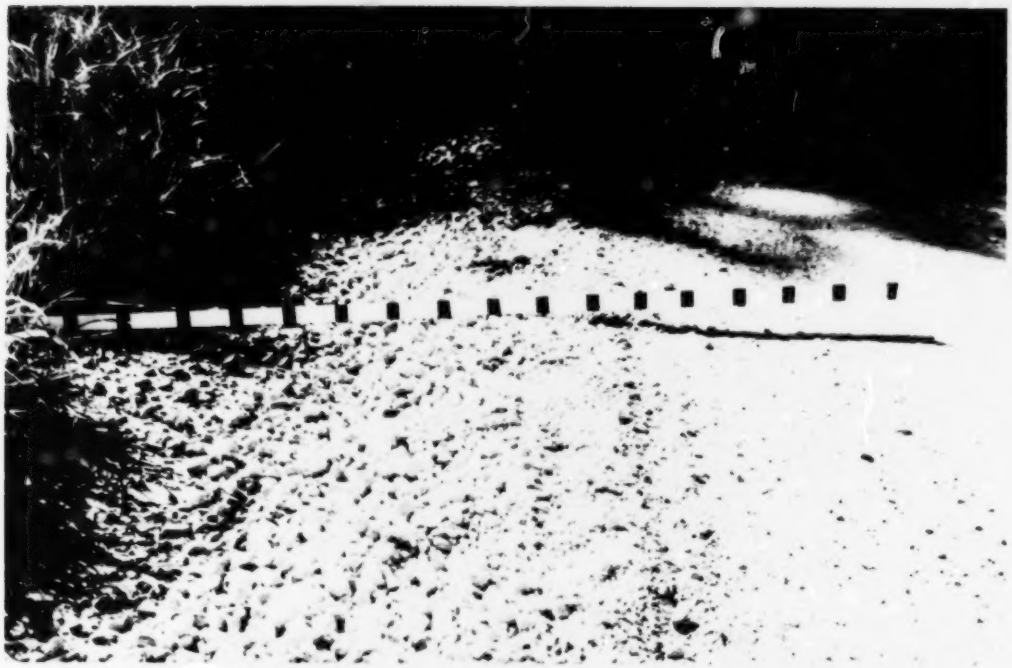
Class	Guidelines
Intermittent	Less than 20% of the roadway surface area affected. Distress spotted over localized area only.
Frequent	20 to 50% of the roadway surface affected. Distress spotted evenly over length of road section or over localized area only.
Extensive	Greater than 50% of the roadway surface affected. Distress spotted evenly over length of road section.



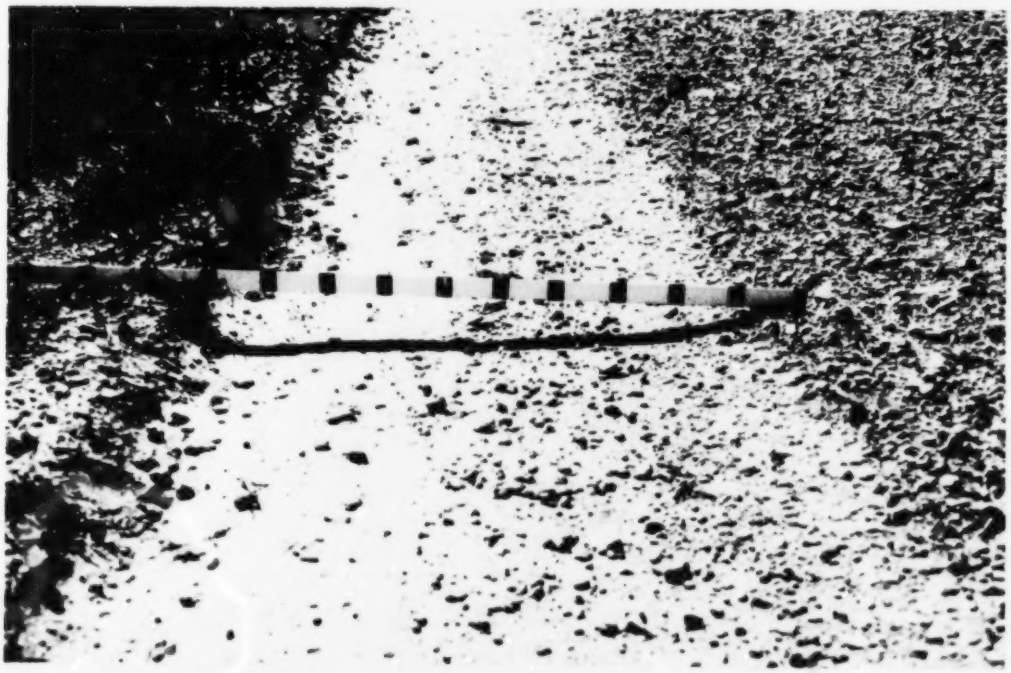
Slight Excessive Height

Slight Excessive Height

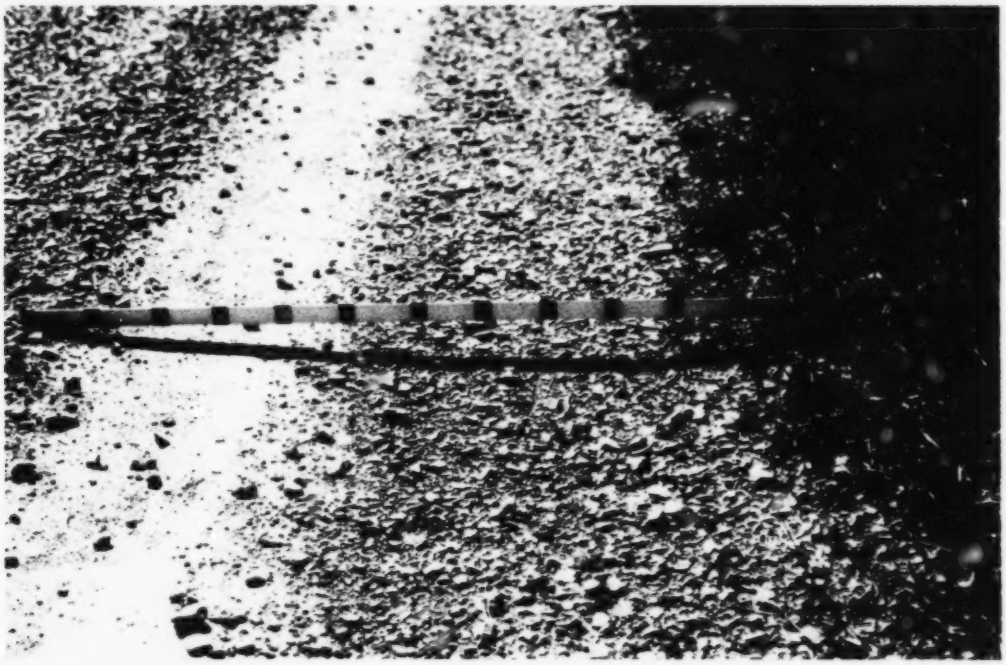
Moderate Excessive Height



Moderate Excessive Height



Severe Excessive Height



Severe Excessive Height

Treatments

Evaluation		Suggested Maintenance Treatment Alternatives
Severity	**Density**	
Slight	Intermittent	• No action
	Frequent	• No action
	Extensive	• No action
Moderate	Intermittent	• Dragging and rolling
	Frequent	• Dragging and rolling
	Extensive	• Dragging and rolling
Severe	Intermittent	• Dragging and rolling
	Frequent	• Dragging and rolling
	Extensive	• Dragging and rolling
		• Rehabilitation candidate

Shoulder Distress

Ponding

Description:

Distortion in the form of depression, dip or hump which create a reservoir for trapped surface water at the roadway surface junction with the shoulder.

Possible Causes:

1. Insufficient roadway width with traffic loading near or at pavement edge or at shoulder.
2. Insufficient structural strength of shoulder to support traffic loads.
3. Improper roadway and shoulder maintenance.

Severity:

Class	Guidelines
Slight	Depression or pond less than 50 mm deep and 600 mm in size.
Moderate	50 to 150 mm in depth and 600 to 1800 mm in size.
Severe	Greater than 150 mm in depth and 1800 mm in size.

Density:

Class	Guidelines
Intermittent	Less than 20% of the roadway surface area affected. Distress spotted over localized area only.
Frequent	20 to 50% of the roadway surface affected. Distress spotted evenly over length of road section or over localized area only.
Extensive	Greater than 50% of the roadway surface affected. Distress spotted evenly over length of road section.

Slight Ponding

Slight Ponding

Moderate Ponding

Moderate Ponding

Severe Ponding

Severe Ponding

Treatments

Evaluation		Suggested Maintenance Treatment Alternatives
Severity	**Density**	
Slight	Intermittent	• No action
	Frequent	• Dragging and rolling
	Extensive	• Dragging and rolling
Moderate	Intermittent	• Dragging and rolling
	Frequent	• Dragging and rolling
	Extensive	• Dragging and rolling
Severe	Intermittent	• Dragging and rolling
	Frequent	• Dragging and rolling
	Extensive	• Dragging and rolling
		• Rehabilitation candidate

Shoulder Distress

Overgrowth

Description: Vegetation growth overruns shoulder and reaches or approaches roadway edge.

Possible Causes:

1. Shoulder too narrow.
2. Improper maintenance practice.

Severity:

Class	Guidelines
Slight	Vegetation growth begins to creep past the shoulder rounding line.
Moderate	Vegetation growth past the shoulder rounding line and onto the main portion of shoulder area.
Severe	Vegetation growth half-way between the shoulder rounding and roadway surface edge, or even right to the roadway surface edge.

Density:

Class	Guidelines
Intermittent	Less than 20% of the roadway surface area affected. Distress spotted over localized area only.
Frequent	20 to 50% of the roadway surface affected. Distress spotted evenly over length of road section or over localized area only.
Extensive	Greater than 50% of the roadway surface affected. Distress spotted evenly over length of road section.

Slight Overgrowth

Moderate Overgrowth

Severe Overgrowth

Treatments

Evaluation		Suggested Maintenance Treatment Alternatives
Severity	**Density**	
Slight	Intermittent	• No action
	Frequent	• No action
	Extensive	• No action
Moderate	Intermittent	• Dragging
	Frequent	• Dragging
	Extensive	• Dragging
Severe	Intermittent	• Dragging
	Frequent	• Dragging
	Extensive	• Dragging

8/ References

[1] **Chong, G.J., Phang, W.A., Wrong, G.A., *Manual for Condition Rating of Flexible Pavements - Distress Manifestations,*** Report SP-004 (revised as SP-024, 1989). Ministry of Transportation, Ontario, Canada, 1975. Presented at the Transportation Research Board, Washington, D.C., 1976.

[2] **Chong, G.J., Phang, W.A., Wrong, G.A., *Manual for Condition Rating of Rigid Pavements - Distress Manifestations,*** Report SP-005. Ministry of Transportation, Ontario, Canada, 1977.

[3] **Chong, G.J., Phang, W.A., Wrong, G.A., *Manual for Condition Rating of Surface Treated Pavements - Distress Manifestations,*** Report SP-021. Ministry of Transportation, Ontario, Canada, 1989.

[4] **Chong, G.J., Phang, W.A., Wrong, G.A., *Flexible Pavement Condition Rating - Guidelines for Municipalities,*** Report SP-022. Ministry of Transportation, Ontario, Canada, 1989.

[5] **Hajek, J.J., Phang, W.A., Wrong, G.A., Prakash, A., Stott, G.M., *Pavement Condition Index (PCI) for Flexible Pavements,*** Report PAV-86-02, Ministry of Transportation, Ontario, Canada, 1986.

Appendix A
A Guide for Completing the "Gravel Surface Roadway Condition Evaluation Form"

Road Identification

1. **Location** — A written description of the beginning (From) and the ending (To) of the section.

   The *From —To* direction must be in the direction of increasing Linear Highway Reference System (LHRS) numbers, i.e., from south to north and from east to west, and the direction is independent of traffic direction.

   The basic description that is already used and stated in the LHRS listing should be used whenever possible. If the LHRS listing shows several descriptions for one LHRS number, choose the description that is most easily recognizable in the field.

   An additional description, such as landmarks and buildings, may be added to the basic description. This information will also be stored by the computer and may help to locate the section in the field.

2. **LHRS (Begins)** and **(Offset)** — Linear Highway Reference System Number and Offset distance in kilometres for the beginning (From) of the section.

3. **Section Length** — The length of the section in kilometres.

4. **Traffic Direction** — The direction traffic moves in the section. If the evaluation is for all lanes (e.g., a 2-lane highway), use the code B, meaning BOTH directions. If only one lane of the 2-lane highway is evaluated, record the appropriate traffic direction code.

5. **District** — Number of the District in which the section is located. Enter the information right justified. For example, District 9 would be as:

	9

6. **Highway** — Enter the highway number and make it right justified. For example, Highway 15 would be entered as:

		1	5

   If the section has more than one highway number, for example, Hwy 35/115, use the lowest of the two numbers. However, if the section in question overlaps with a freeway, the freeway (400 series) number should be used. Highway numbers may also be entered alphanumerically:

		7	A

7. **Survey Date** — The year and month in which the section was evaluated.

8. **PCR** — Pavement Condition Rating. Table B-1 is a guide for estimating the PCR number on a scale from 0 to 100.

9. **Contract Number** — The last contract number. This requires a 5 digit number. If the section covers more than one contract, the additional contract may be recorded under "Other Comments". If the contract number is not available, leave it blank.

10. **W.P. number** — The Work Project Number should always be entered if it's available.

ROADWAY EVALUATION

Surface Distress Manifestations

Evaluation is made in terms of surface distress which may cause accelerated loss of serviceability and/or distresses which may trigger maintenance actions. It is a measure related to the structural adequacy of the roadway and the cost of maintaining and preserving the capital investment of the road structure [5].

Surface distress manifestations are evaluated by the rater walking and/or driving slowly over the evaluation section and checking off all the pavement distress manifestations in their appropriate spaces (Figure A-1).

The distresses are listed under two subgroups:

a/ **Surface Defects**
- Loose Gravel
- Dust
- Potholes
- Breakup

b/ **Surface Deformation**
- Washboard
- Rutting
- Flat or Reverse Crown
- Distortion

Shoulder Evaluation

In the case of gravel surface roads, shoulder condition has significant influence on the Pavement Condition Rating (PCR) as it can affect pavement serviceability.

The distress is evaluated and identified as the "Right" or "Left" shoulder by the direction of the roadway.

On the road running from south to north, the shoulder on the east side is always "Right". On a road running from east to west, the shoulder on the north side is always "Right".
The shoulder distresses are listed as:
- Excessive Height
- Ponding
- Overgrowth

Shoulder distresses are evaluated by the rate in the same manner as evaluating roadway surface and the distress is checked off in its appropriate spaces on the form (Figure A-1).

Pavement Condition Rating (PCR)

Pavement Condition Rating is a subjectively-derived rating number describing the level of serviceability based on the evaluation of the surface distresses. It is an assessment of the overall performance related to actual observable surface characteristics.

Ministry of Transportation Ontario

GRAVEL SURFACE PAVEMENT CONDITION EVALUATION FORM

Location From: _____ **To:** _____

LHRS [ ][ ][ ][ ][ ] BEGINS [ ][ ][.][ ] OFFSET km **Section Length** [ ][ ][.][ ] LENGTH km **District** [ ][ ] **Highway** [ ][ ][ ][ ]

Survey Date [ ][ ] YEAR [ ][ ] MONTH **PCR** [ ][ ][ ]

Traffic Direction [ ] B : BOTH DIRECTIONS N : NORTH BOUND S : SOUTH BOUND E : EAST BOUND W : WEST BOUND

Contract No. [ ][ ] – [ ][ ][ ] **WP No.** [ ][ ][ ][ ] – [ ][ ] – [ ][ ][ ]

Roadway Surface Distress Manifestation			SEVERITY OF DISTRESS			DENSITY OF DISTRESS Extent of Occurrence,%		
			Slight	Moderate	Severe	Intermittent	Frequent	Extensive
						< 20	20-50	> 50
			1	2	3	1	2	3
SURFACE DEFECTS	Loose Gravel	1						
	Dust	2						
	Potholes	3						
	Breakup	4						
SURFACE DEFORMATION	Washboard	5						
	Rutting	6						
	Flat / Reverse Crown	7						
	Distortion	8						

Shoulder Distress Manifestation	SEVERITY OF DISTRESS						DENSITY OF DISTRESS Extent of Occurrence,%					
	Right			Left			Right			Left		
	Slight	Moderate	Severe	Slight	Moderate	Severe	Intermittent	Frequent	Extensive	Intermittent	Frequent	Extensive
							< 20	20-50	> 50	< 20	20-50	> 50
	1	2	3	1	2	3	1	2	3	1	2	3
EXCESSIVE HEIGHT												
PONDING												
OVERGROWTH												

Distress Comments (Items not covered above) _____

Suggested Maintenance Treatment: _____

Evaluated by: _____

Figure A-1/ Gravel Surface Pavement Condition Evaluation Form

Appendix B
A Guide for Completing the "Pavement Condition Report Form"

District No.

Number only of district: 1 to 20.

Hwy No.

If highway location has more than one number, list all with the lowest number first, e.g., 7, 15 and 29.

W.P. No.

List the current work project number if available.

Length

Indicate the length in kilometres and decimals of a kilometre. If there is a discrepancy between the distance table or map distance and actual car distance, use actual car distance if odometer reads correctly.

Location

The location should be referenced to the junction of highways or secondary highways, or to city or town limits. Do not refer to small villages, rivers, municipal boundaries or other landmarks which are not readily identifiable on the official road map.

The sections should run from east to west or from south to north. The current MTO Reference System number of the closest numbered location to the east or south of each end of the project should be given, together with the offset distance from this location (if any).

Last Contract No.

Indicate the number or numbers of previous contracts on the section of highway. This information will be used for input and retrieval from PAMFIS.

Surface

Type:	Indicate surface type only, i.e., gravel surface.
Width:	Measure with tape at the time of survey. If variable, show minimum and maximum widths.
Shoulders:	Estimate width or, if variable, show minimum and maximum widths.

Traffic

Indicate the year of the traffic count, AADT and SADT, and the percentage of truck traffic if known.

Soils Data

Indicate the topography and soil types. This information may be supplemented by reference to Putnam and Chapman or to regional soil maps, if necessary.

Pavement Structure Data

Indicate any rehabilitative work, or other maintenance repair work carried out and the approximate year the work was done. (In the case of evaluating gravel roads, Pavement refers to the roadway.)

Performance and Condition

This should be indicated by a detailed summary of the surface defects, distortion, etc. The Manual for Condition Rating of Gravel Surface Roads describes various forms of distress, and details the terminology to be used to describe them. The descriptive terms used in the manual have been standardized and should be strictly followed to allow accurate comparison of information from various sources.

Remarks

This section should include general comments on points such as:

- type of W.P. if this has been assigned,
- possible changes in type or volume of traffic,
- frost heaves,
- ditching,
- safety features,
- alignment, and
- possible combination with other projects.

Proposed Remedial Measure

Indicate if routine or other maintenance measures, will be adequate. If rehabilitation is proposed, indicate the proposed rehabilitation design, and indicate the year when it should be carried out.

Program Year

Indicate the present program year, if any, and any suggested changes. If work is required within the 5-year period, indicate the year. If no work is required at present, estimate whether work will be required in 5 to 10 years or after 10 years. This estimate is of value to the Highway Program Administration Office.

Date of Survey

Indicate the day, month and year.

Distribution

Distribution is made to Regional Staff. Copies should be sent to the District Office and to the appropriate Head Office staff in the:

- Design Evaluation and Pavement Section,
- Reference and Inventory Systems Section, and
- Highway Project Control Section.

Figure B-1 Pavement Condition Report

Ministry of Transportation

Regional Geotechnical Section

Pavement Condition Report

Condition Rating

District No._____Hwy. No.____W.P. No._____Length_____

Location:_____

Reference No. From _____ To_____ Last Contract No._____

Offset Distance _____ _____ R.C.R. _____

Pavement: Type _____ Width_____ Shoulder: Width _____

Traffic: Year _____ A.A.D.T. _____ S.A.D.T._____% Trucks_____

Soils Data:

Pavement Structure Data:

Maintenance History:

Performance and Condition:

Remarks:

Proposed Remedial Measures:

Program Year: Present_____ Suggested _____

Date of Survey: _____ Prepared by: _____

Table B-1

A Guide for the Estimation of Pavement Condition Rating and Suggested Maintenance or Rehabilitation for Gravel Surface Roads		
Roadway surface well shaped with well defined shoulder between roundings. No surface distress manifestations, just a "slight" classification for dust and loose gravel. No frost heave or soft spots when evaluation is made in late spring. Good drainage for surface run-off on roadway and shoulder.	80-100	Routine Maintenance.
Roadway surface well shaped with shoulder between roundings.Some distress manifestations in slight to moderate class such as loose gravel, dust, potholes, etc. There may be a few soft spots of frost heaving when evaluation is made in late spring. Good drainage for surface run-off on roadway and shoulder.	60-79	Routine maintenance. Dust control may be necessary for residential areas.
Mixture of properly shaped roadway surface and improperly shaped areas. Shoulder distress manifestations such as ponding and overgrowth evident between roundings in slight to moderate class. Various surface distress manifestations present such as washboarding, potholes, etc., in slight to moderate class. Localized breakup may be present.	40-59	Increased routine maintenance necessary. Addition of gravel and dust control additives become necessary.
Majority of roadway surface improperly shaped. Shoulder distress manifestations in moderate to severe class. Various roadway surface distress manifestations making travel unpleasant because of washboarding, dust, potholes, distortions, etc. Localized breakup areas.	20-39	Maintenance with addition of gravel necessary. Dust control a must for residential areas. Some portion may need rehabilitation.
Flat or reverse crown, severe roadway surface distresses such as washboarding, loose gravel, potholes, etc. Very rough on vehicles from severe distortion and breakup areas. Severe shoulder distresses trapping surface water at all times. Little or no gravel due to severe wind-row of loose gravel, on roadway surface.	0-19	Rehabilitation necessary.